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Editorial

Terrace landscapes. Editorial to the special issue

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Found worldwide, terraced landscapes are a hallmark of intensive agriculture with deep historical, anthropological and archaeological roots (Acabado, 2012; Amborn, 1989). With their geometric lineout, terraced landscapes also represent one of the most obvious expressions of human transformation of the environment and of human environmental management. Seen from the ground, they impress for the intricacy of their interconnected walls, channels (when irrigated) and passages. Seen from above, they strike for their coherence and integration on top of underlying landforms. But terraced landscapes are far from barely affecting the topography of a region. The implementation of terraced fields is paired with significant environmental transformations, e.g. in land cover, soil properties, microclimate, insolation and/or geomorphology (Arnáez et al., 2015; Evans and Winterhalder, 2000; Ramos et al., 2007; Treacy and Denevan, 1994). In fact, environmental changes linked to terraced agriculture have been claimed to provide some of the earliest evidence of large-scale human impact on the Earth system (Kaplan et al., 2011; Ruddiman et al., 2011). For instance, together with animal farming, the spread of wet rice cultivation in SE Asia, often paired with the development of terraced paddy fields, has been claimed to have perceptibly contributed to modifying the composition of the atmosphere starting c. 5 ka BP, well before the beginning of the industrial revolution (Ellis et al., 2013; Fuller et al., 2011; Ruddiman, 2003; Ruddiman, 2013; Ruddiman et al., 2015).

Terraced landscapes have the potential to convert sloped terrains into productive agricultural land by increasing humidity retention in soils and by reducing surface erosion, thus allowing long-term cultivation (Donkin, 1979; Hudson, 1995). However, when mismanaged or abandoned, terraced landscapes are more prone to erosion than woodland, with landslides posing a serious hazard to agrarian fields and urbanized areas downslope (Crosta et al., 2003). Understanding historical sustainability pathways in terraced systems in the face of existing social and environmental challenges is important to warrant human wellbeing in rural areas and develop viable agrarian strategies. In fact, from a socio-economical standpoint, terraced landscapes can contribute to the integration of small-sized communities into the global market through the pathways of sustainable growth (Balbo et al., 2016; UN, 2015).

The main aim of this volume is to provide an overview of research on terraced systems that have been in use over the long period (decades, centuries and millennia). The approach is interdisciplinary, with contributions from the environmental (agronomy and ecology) and social (archaeology and anthropology) sciences. Authors explore the impact of terracing on pre-existing environments and ecosystems but also its social implications in terms of technological innovation, management and governance strategies. Given that the agricultural food-production system is globally increasingly affected by environmental and social pressure, the long-term study of terraced system provides an essential contribution. Such systems integrate tradition and innovation, but also environmental and social know-how, in the constant redefinition of new ways to supply the food needs of an ever-growing human population. Works collected in this volume contribute to deepening our knowledge on how different societies have been able to successfully maintain through time social-ecological systems based on terraced agriculture (see Table 1).

1. Contributions

1.1. When is a terrace not a terrace? The importance of understanding landscape evolution in studies of terraced agriculture (Ferro-Velasquez et al.)

Previous studies have focused on the origin and impact of slope agriculture developments in Ethiopia during and after the Aksumite period, starting c. 100 CE (Sulas et al., 2009; French et al., 2009). Here, Ferro-Velasquez et al. looks at the extensive terraced landscape at Konso, southwest Ethiopia (UNESCO World Heritage Site since 2011), possibly originated 500 years ago (Amborn, 1989) and currently covering an estimated surface of c. 200 km^2. Within Konso, the Sahayto area has been chosen as representative of the historic heartland of the Konso settlement. Konso is used as a point in case to demonstrate the gradual and adaptive development of traditional terrace systems. Gradual development in traditional terraced landscapes is presented as an intrinsic feature in opposition with modern terrace developments, which may be built over broad areas in a single construction phase. Following the proposed approach, the evolution of terraced landscapes becomes a proxy of changes in farming practices, as well as in social, economic and climatic conditions.

The provocative title proposed by Ferro-Velasquez et al.,

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Table 1
List of contributions with location and chronology of presented case studies.

	Authors	Case study	Topography	Climate	Period
1	Ferro-Velasquez et al.	Konso, SW Ethiopia, Africa	Mountain c. 1400–2100 m asl	Dry/cold to sub-humid	Possibly Aksumite (c. 100–940 CE) to present
2	Ridder at al.	Politiko-*Troullia*, Cyprus	Hill c. 400 m asl	Semi-arid	Cyprus Bronze Age (c. 2700 BCE) to Medieval period (1571 CE)
3	Jiang et al.	Longji, Guangxi, China	Hill and mountain c. 400–900 m asl	Mid-subtropical monsoon	Late Yuan Dynasty (c. 1300 CE) to present
4	Londoño et al.	Wari, Cerro Baul, S Peru	Mountain up to c. 2000–2500 m asl	Dry	Wari (c. 600–1000 CE) to present
5	Fukamachi	Kamiseya and Moriyama, satoyama landscapes, Japan	Hill c. 100–600 m asl	Humid sub-tropical	Historical and modern (1900s with focus on 1970s transition) to present-day
6	Puy et al.	Ricote, Murcia, Spain	Hill c.	Semi-arid Mediterranean	Medieval (c. 900 CE) to present (focus on 2000s transition)

questions the very definition of agricultural terrace, a generic term encompassing a range of different structures built in different contexts to solve different problems, including e.g. improving soil quality, mitigating soil erosion or fostering water retention. So much so that within the same terrace system, sectors developed in different periods may have responded to different needs. Archaeobotanical characterisation, archaeological stratigraphy and soil formation analysis are used in Konso to define the function, efficacy, construction sequence and environmental consequences of terraces from different construction phases. Overall, the authors argue for the necessity to understanding the historical context to assess the efficacy, sustainability or resilience of any terrace system from an environmental management perspective. Their approach is interdisciplinary and based on the comparison of data from historical archives with modern field observations. Specifically, soil descriptions (micromorphology), geochemistry, molecular composition of the soil organic matter and stratigraphy are used to achieve a long-term perspective.

Besides demonstrating the potentially important role of slash and burn clearance in the early phases of land appropriation (accounted for in the oral tradition of the *poqualla* dynasties), a key result of Ferro-Velasquez et al.'s work is the revelation of the importance of *yela* terraces in the early stages of development of the Konso terrace system. *Yela* terraces consist of irrigable riverside plots obtained through the construction of inclined drystone walls acting as traps for sediments of alluvial and colluvial origin. Alluvial sediment input was regulated through a system of artificial offtakes (*dotatta*) and channels (*kava*), and upslope terraces were constructed to protect the *yelas* by regulating runoff and soil erosion and favouring the creation of new high-quality soil. Primarily built to regulate runoff, upslope terraces were eventually farmed. The novel perspective provided by this work indicates that the Konso terrace system was built to regulate rather than prevent soil erosion. In this context, *yela* fields, mostly overlooked in previous land management programmes, are put back into perspective as the core agronomic resource, and slope terraces, previously considered central, are interpreted as a secondary regulatory element within the system.

1.2. Economic and social activities on ancient Cypriot terraced landscapes (Ridder et al.)

Ridder et al. analyse the distribution of archaeological potsherds on the surface of the Politiko-*Koloiokremmos* terrace system, near the archaeological site of Politiko-*Troullia* in central Cyprus, as a proxy to understand off-site behaviour during the Bronze Age period. The Politiko-*Troullia* Bronze Age settlement was occupied around 2000 BCE (Falconer and Fall 2013). Previous excavations suggest that its inhabitants relied on a mixed subsistence economy, involving agriculture (olives, grapes and figs), husbandry (sheep and goat), hunting (deer) and metal smelting (copper) for which wood from olive tree, pine and oak were used as fuel.

Archaeological artefacts (potsherds, grinding and gaming stones) collected from the surface of the Politiko-*Troullia* and Politiko-*Koloiokremmos* terrace systems, were grouped by Ridder et al. into four chronological groups: (1) Prehistoric Bronze Age (2700–1650 BCE), (2) Protohistoric Bronze Age (1650–1050 BCE), (3) Iron Age-Hellenistic (1050–50 BCE), (4) Roman-Medieval (50 BCE–1571 CE) (Smith, 2014). The authors combined ground and aerial mapping of existing terraces with the use of commercial GIS software to analyse emerging distribution patterns. In addition, soil resistivity and excavation were deployed to identify Bronze Age stone structures buried under the surface of the analysed terraces.

The survey revealed dense concentrations of potsherds, grinding stones (used for ore processing) and gaming stones (associated elsewhere with ritual, communal and living activities) well beyond the vicinity of the Politiko-*Troullia* Bronze Age settlement, and as far as the eastern edge of the Politiko-*Koloiokremmos* terrace system. Ridder et al. argue that, beside agriculture, terraces surrounding the Bronze Age site of Politiko-*Troullia* were frequented for metallurgy and other social and economical activities. In conclusion, the authors claim that copper ore reduction and primary smelting in some of the easternmost terraces surrounding Politiko-*Troullia* was probably favoured by the combination of a predominantly flat topography, the availability of fuel from the nearby woodland, the proximity to water (for processing and transportation) and a favourable wind exposure. The same elements would have contributed to making the terraced area attractive for other socio-economical activities.

1.3. A record of palaeoenvironmental change inferred from organic geochemical characteristics of soil in Longji ancient Terrace, Guangx, China (Jiang et al.)

In spite of increasing scientific efforts, and mostly due to the sheer size of the subject matter, the agricultural history and archaeology of China remain largely unexplored. While important discoveries have been made in recent years on the origins of agriculture, and specifically rice agriculture in China (Cohen, 2011; Zhang et al., 2012; Zhao, 2011), Jiang et al. open a window on a more recent but significantly less known period, exploring the past 600 years of terrace agriculture development in the Longji Terrace system (800 m asl, Guangxi, South China).

The Longji Terrace system reveals at least four distinct phases of transformation, associated to different climate phases and agricultural strategies (crop type, farming intensity). Jiang et al. propose a multi-proxy study of organic geochemical proxies (TOC, organic carbon stable isotope and n-alkanes) preserved within a terrace